



Armed Forces College of Medicine AFCM



Physiology of From Puberty to Menopause

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INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be

- able to
- 1- Summarize the hormonal changes that occur at puberty in females.
 - 2- Describe functions of the placental hormones during pregnancy.
 - 3- Enumerate the functions of human chorionic gonadotropins (hCG).
 - 4- Outline the hormonal changes and their physiologic effects during menopause.

PUBERTY (Adolescence)



Def:

- It is the period when the endocrine and gametogenic functions of the gonads have first developed to the point where reproduction is possible.

Thus puberty is the final maturation of the reproductive system and onset of adult sexual life.

- It occurs between the ages of
 - * 8 -13 years in girls
 - * 9 -14 years in boys

PUBERTY (Adolescence)



Stages of puberty:

I. In Girls:

- Thelarche** (development of breast).
Pubarche (development of axillary & pubic hair).
Menarche (first menstrual period).

II. In boys:

Enlargement of the testes, penile enlargement, growth of the glans penis and finally adult genitalia.

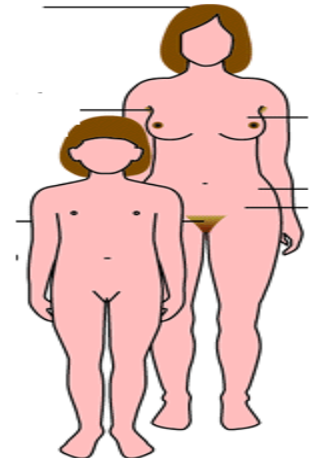
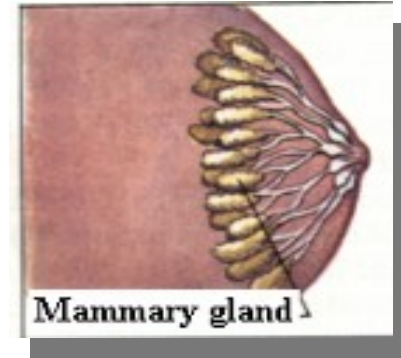
The maturation of gonads is accompanied by:

- Acceleration of growth (growth spurt).
- Development of 2ry sexual characters.

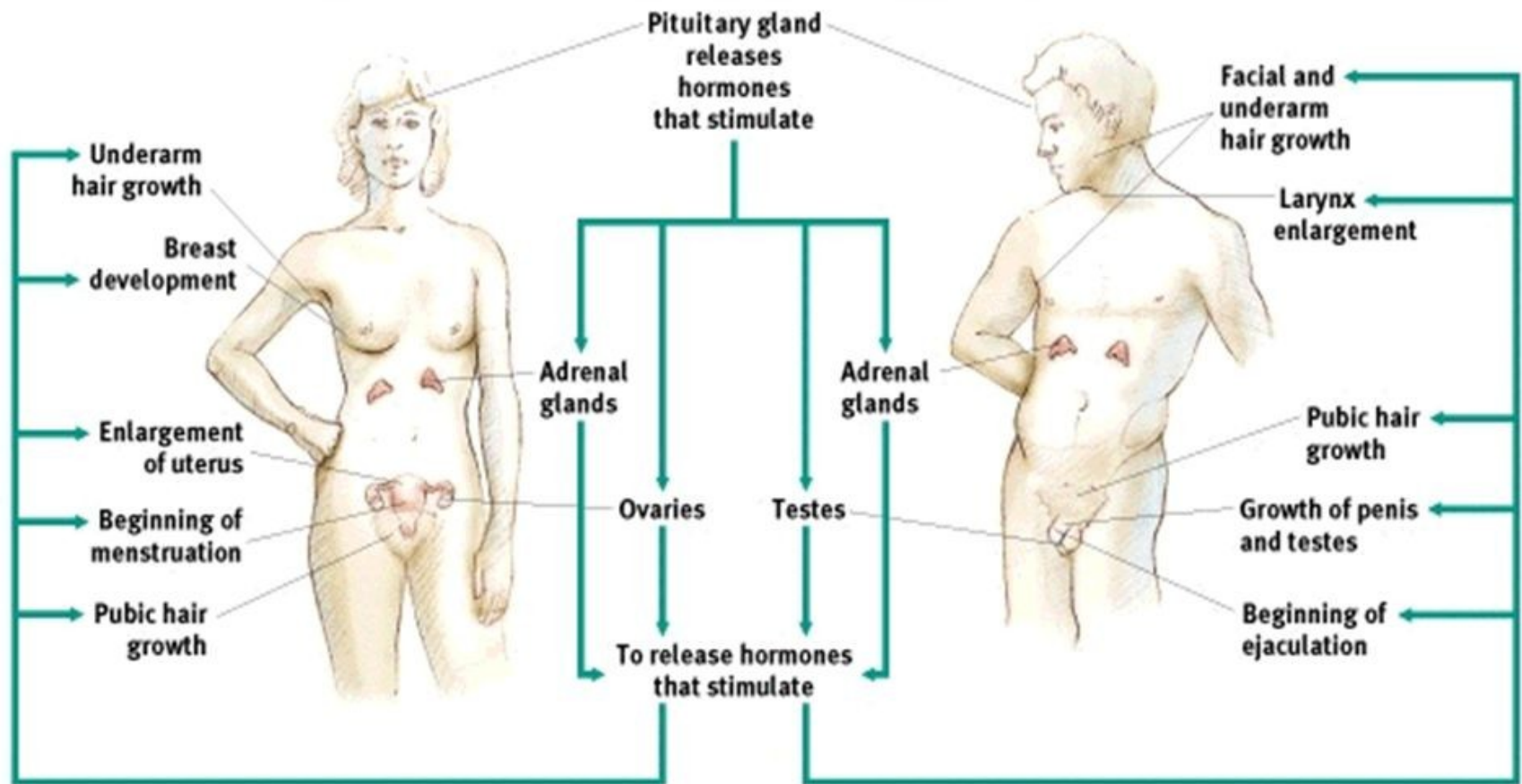
What is adrenarche?

An increase in the secretion of adrenal androgens at the time of puberty.

Due to an increase in the activity of 17 -hydroxylase.



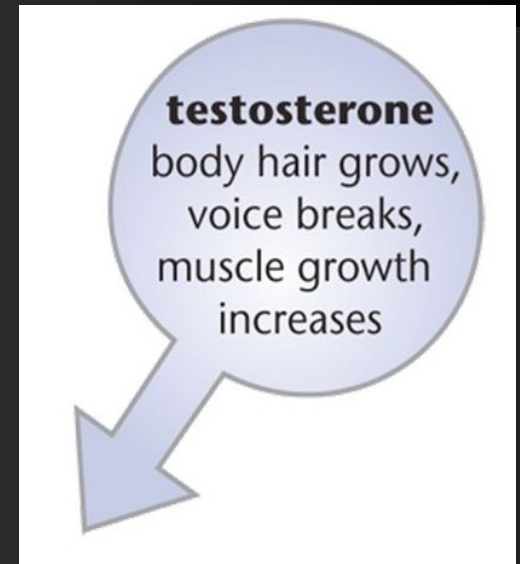
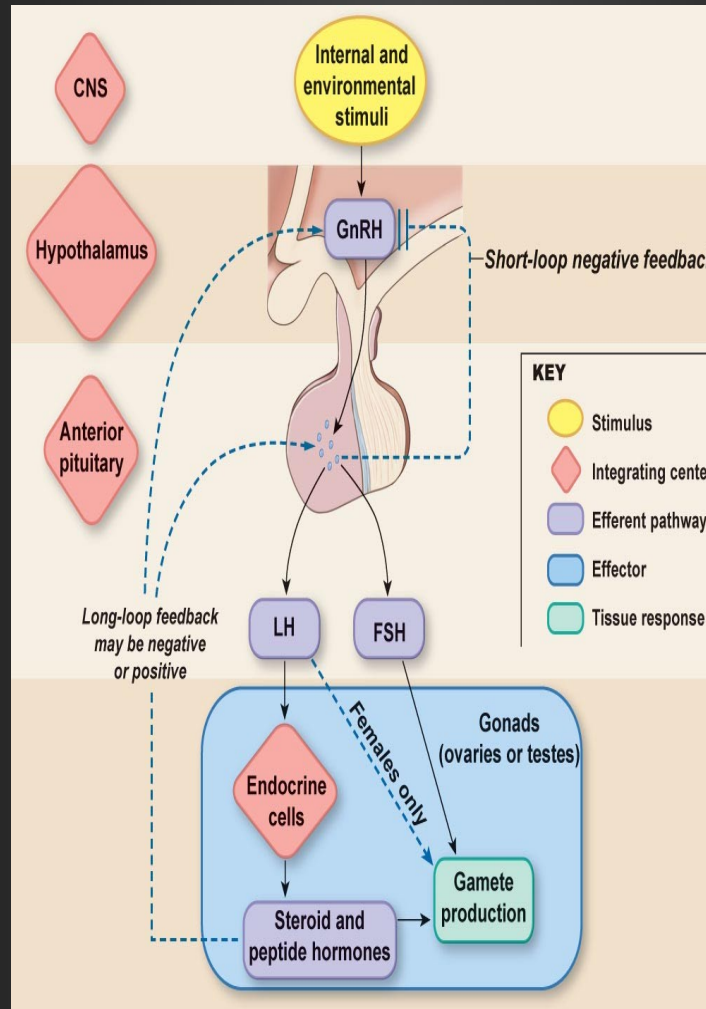
Body Changes at Puberty



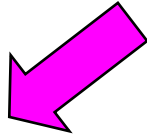


Control of the onset of puberty:

- It is caused by gradual, pulsatile \uparrow in GnRH secretion.
- This \uparrow in GnRH may be initiated by \downarrow in **melatonin**, secreted by the pineal gland in the brain.
- It now appears that **leptin**, may be the link between body weight and puberty.
e.g:
Young women who engage in strenuous exercises & lose weight stop menstruating.



Disorders of puberty



Sexual precocity

True precocious puberty

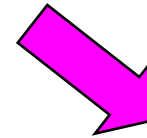
Early GN
secretion.

e.g:
Constitutional

Precocious pseudo puberty

Early development of
2ry sexual character
without
gametogenesis.

e.g:
Exposure of
immature ♀ to
estrogen or ♂ to



Delayed puberty

- **In ♀**

If no menarche till 17 ys.
(*Primary amenorrhea*)

- **In ♂**

If no testicular
development till 14 ys
(*Eunuchoidism*)

e.g:

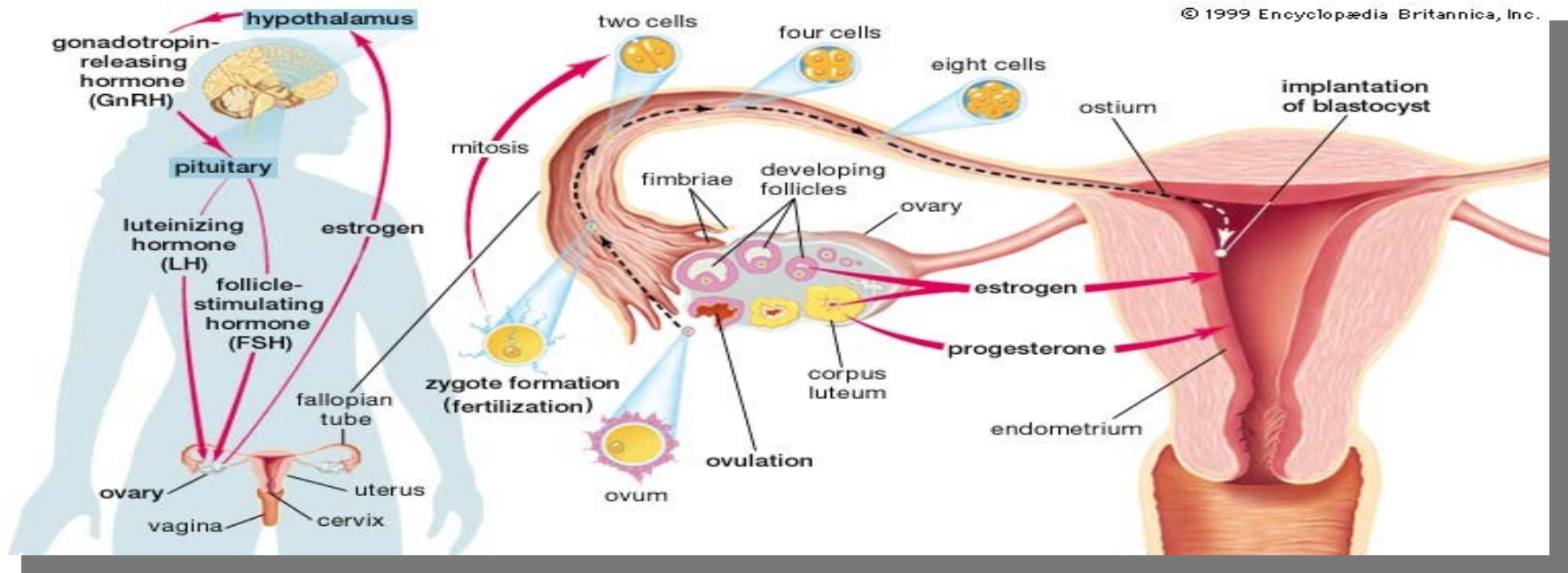
Females with Turner
syndrome (XO)

Endocrine changes in pregnancy

(Placental hormones)

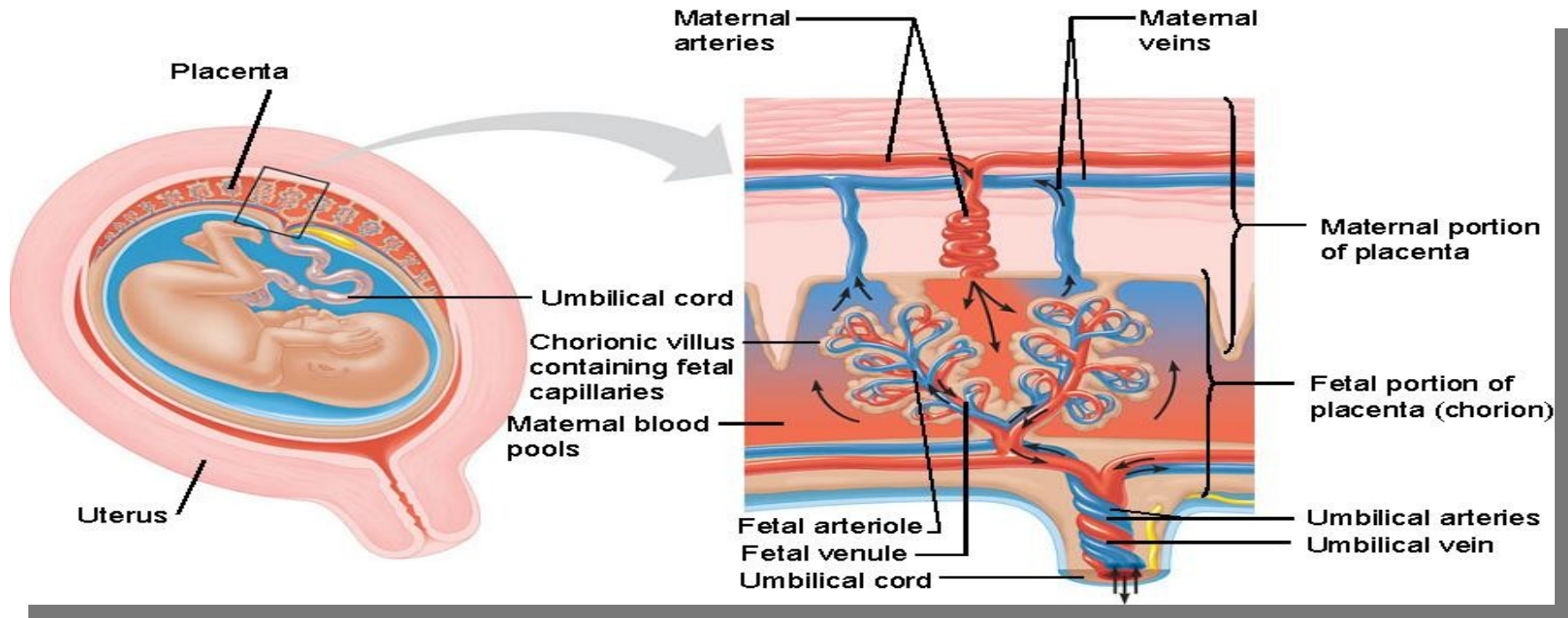


Endocrine changes in pregnancy (Placental hormones)



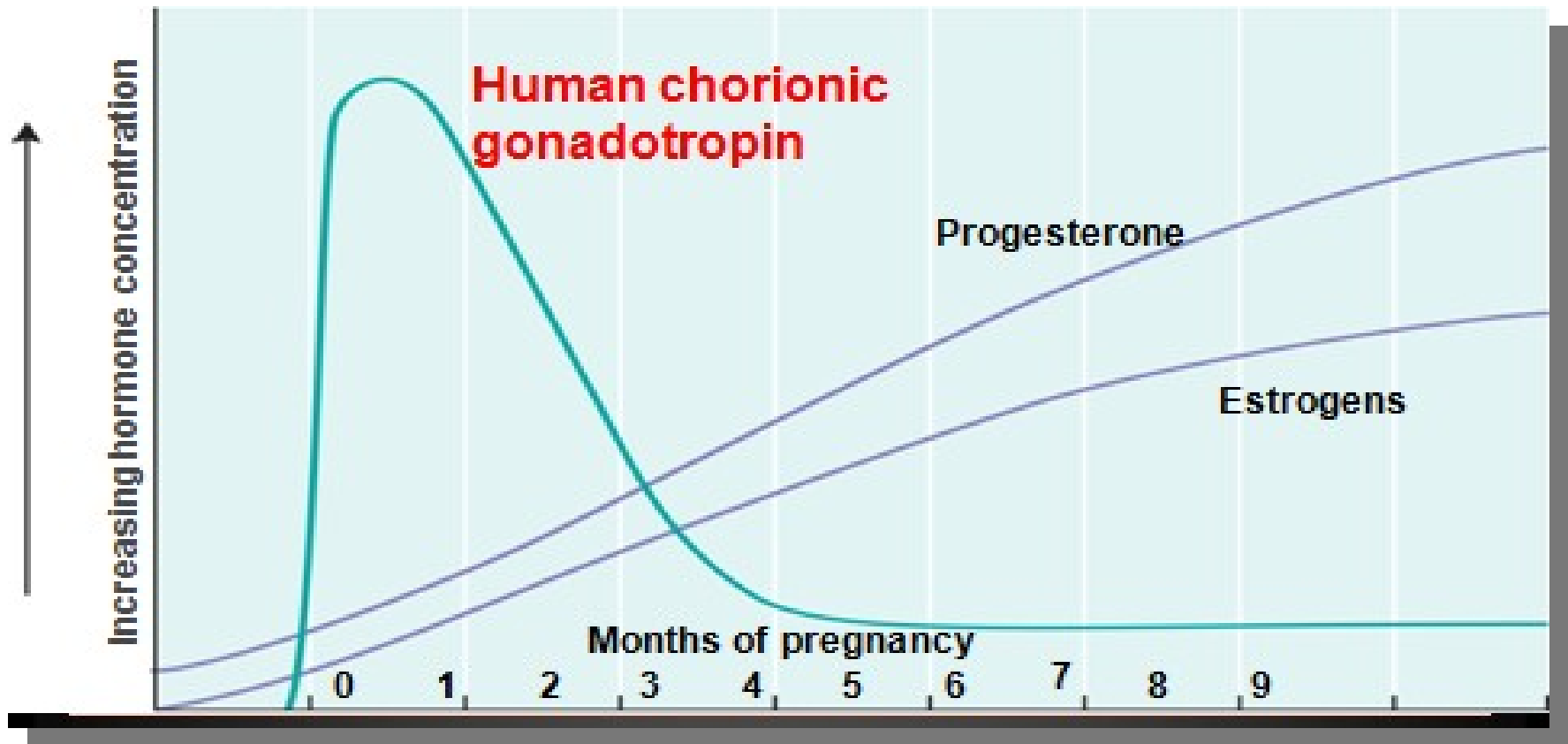
- After fertilization, the corpus luteum in the ovary at the time of fertilization doesn't regress and instead enlarges in response to stimulation by hCG secreted by the placenta (**corpus luteum of pregnancy**).
- Corpus luteum secrete **progesterone**, **estrogen** and **relaxin** that maintain pregnancy.

Endocrine changes in pregnancy (Placental hormones)



- After the 6th week of pregnancy, the placenta produces sufficient estrogen and progesterone to take over the function of the corpus luteum.
- The function of the corpus luteum begins to decline after 8th week of pregnancy.

Endocrine changes in pregnancy (Placental hormones)



- hCG secretion ↓ ↓ after a maximal rise, but estrogen and progesterone secretion ↑ ↑ until just before parturition.

Endocrine changes in pregnancy

(Placental hormones)



I- Human chorionic gonadotropin (hCG):

- It is a glycoprotein secreted by the syncytiotrophoblast in the chorionic villi of the placenta.
- 2 subunits (α & β), α is similar to that of LH,FSH.
- hCG can be detected:
 - in **blood** 6 days after conception.
 - in **urine** 14 days after conception.
 - After 12th week its level starts to ↓.
- hCG is not absolutely specific for pregnancy.

• **Function of hCG:**

- 1- It prolongs the life span of C.L \rightarrow \uparrow P, E & relaxin \rightarrow to *maintain pregnancy* until the placenta fully formed at 12th week.
- 2- *In the male fetus*, HCG \rightarrow synthesis of testosterone \rightarrow development of male internal genitalia & for descent of the testicles into the scrotum.
- 3- hCG \rightarrow (+) the CTZ in the vomiting centre \rightarrow vomiting in early morning (*morning sickness*).

**Trophoblast cells
secrete hCG**



hCG maintains corpus luteum



**Corpus luteum continues
to secrete estrogens and
progesterone**



**Estrogens and progesterone
promote growth, development,
and maintenance of uterine wall**

Endocrine changes in pregnancy

(Placental hormones)



II- Human Chorionic Somatomammotropin (hCS):

- Protein hormone secreted by syncytiotrophoblast.
- Its amount is proportionate to the size of the placenta

□ ↓ hCS is a sign of placental insufficiency.

• **Function:**

- 1- ↓ insulin sensitivity, ↓ maternal **glucose** utilization making more glucose available to the fetus.
- 2- **Lipolytic** □ ↑ free FAs to be used as a fuel by the mother sparing glucose to fetus.
- 3- **Growth** promoting effects & (+) breast

Endocrine changes in pregnancy

(Placental hormones)



III. Placental progesterone:

- Secreted at 1st by C.L □ by the placenta.
- **Functions:** ***maintain pregnancy.....How?***
 1. Maintains secretory function of endometrium □ for **nutrition** of the embryo.
 2. **Suppress the contractions** of the myometrium
(↓ no. of oxytocin receptors, ↓ prostaglandins)
so , prevent spontaneous abortion.
 3. Stimulates breast development (alveoli) to prepare for **lactation**.

Endocrine changes in pregnancy

(Placental hormones)



IV. Placental estrogen:

- Secreted at 1st by C.L □ by the fetoplacental unit.
- **Functions:**
 1. Stimulates the growth of endometrium.
 2. Contraction of myometrium
(↑ no. of oxytocin receptors, ↑ amount of contractile proteins)
So, helps in **expulsion of fetus during labor.**
 3. **Breast** enlargement (duct system).

Endocrine changes in pregnancy

(Placental hormones)



V- Relaxin hormone:

- Secreted by the C.L □ placenta.
- **Functions:**
Facilitate delivery of baby.....**HOW?**
 1. Relaxation the symphysis pubis & pelvic ligaments.
 2. Softening & ripening of cervix.
 3. □ no of oxytocin Rs □ making uterus more sensitive to oxytocin.

Q. What do you think about LH level during pregnancy?

LH which normally maintain the function of CL is suppressed by feedback inhibition by the high level of progesterone & moderate level of estrogen.

Q. Pregnancy is associated with *amenorrhea*. Explain.

Suppression of anterior pituitary hormones (FSH&LH) prevents follicular development and ovulation throughout pregnancy.

PARTURITION

= Labor = delivery = birth

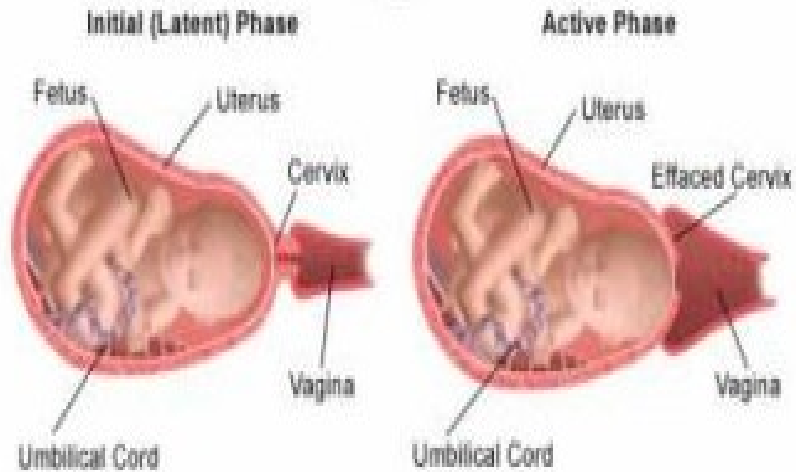


- It is the process by which the baby
- **Requirements for normal labor:**
 - 1- Full cervical dilatation (10 cm).
 - 2- Strong, regular, frequent uterine contractions.



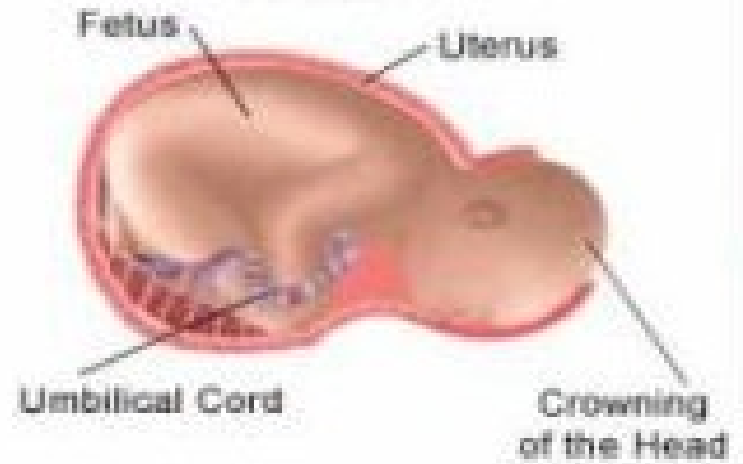
Both are under hormonal control

Stage 1



cervical dilatation

Stage 2



Delivery of the baby

Stage 3



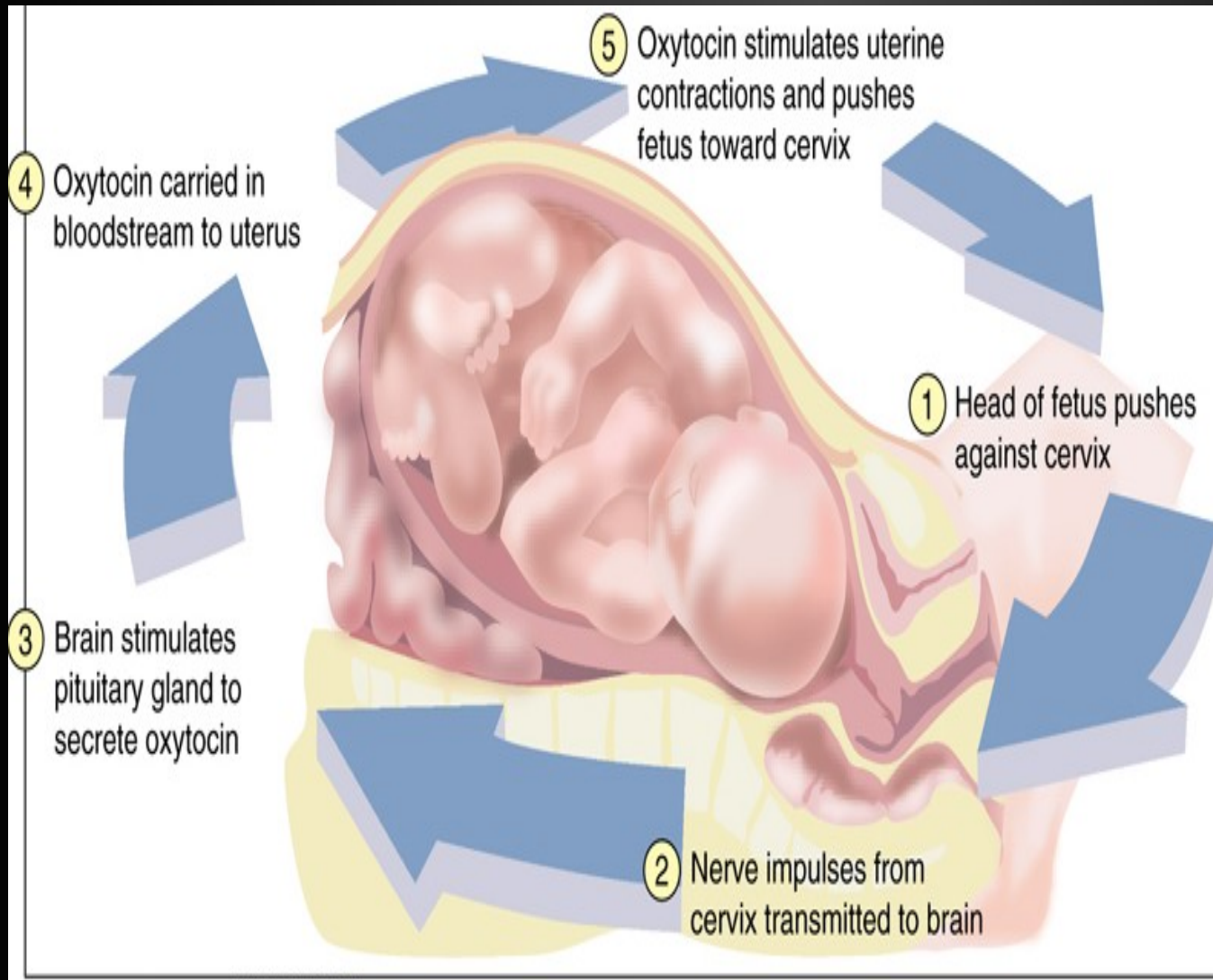
Delivery of placenta

PARTURITION

= Labor = delivery = birth



- **Initiation of labor (mechanism):**
 - The body of the uterus contracts (regular, frequent, strong) □ to expel the fetus.
 - 1- ↑ in E/ P ratio.
 - 2- ↑ in no. of oxytocin receptors in the myometrium (> 100-fold) in response to ↑ estrogen & relaxin.
 - 3- Mechanical stretch of the uterus by the growing fetus.
 - 4- Dilatation of the cervix □ (+) reflexes that lead to **oxytocin** secretion.
 - While the cervix softens and dilates □ to accommodate passage of fetus to vagina then



**The +ve
F.B
mechanism that
↑
oxytocin
secretion.**



PARTURITION

= Labor = delivery = birth



Hormonal control of parturition:_

1) Oxytocin:

- Cervical dilatation \square (+) of mechanoreceptors in cervix \square afferent fibers in spinal cord \square (+) of hypothalamus to release oxytocin from posterior pituitary into blood \square (+) uterine contractions (+ve F.B).
- It \uparrow uterine contractions both direct & through PGs.
- No. of oxytocin receptors is \uparrow ed by estrogen & relaxin.

2) Prostaglandins:

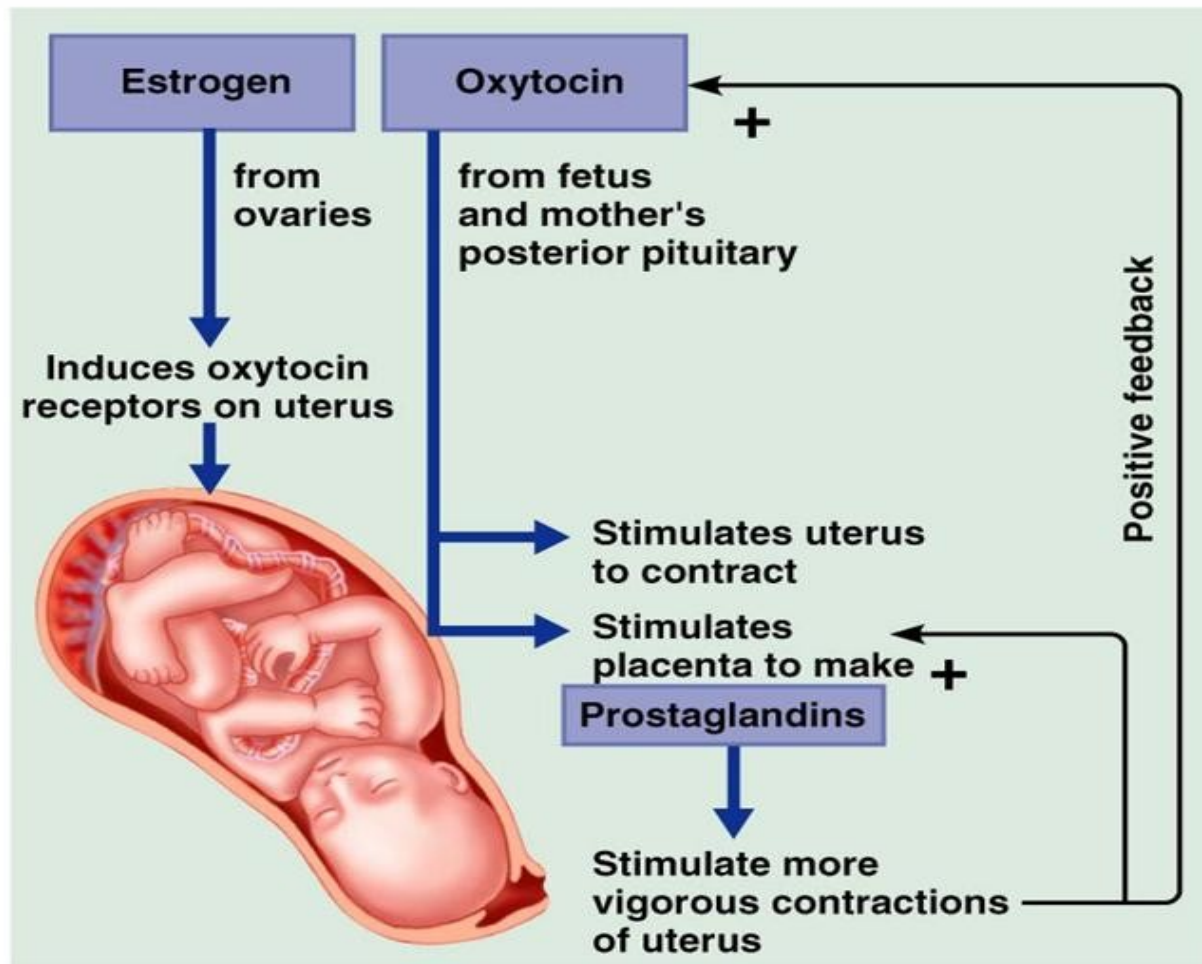
- Released from myometrium in response to oxytocin & also from placenta.
□ through a paracrine action □ (+) uterine contractions.

3) Relaxin hormone:

- □ no. of oxytocin receptors.
- Softens the cervix.
- Relaxation of the pelvic ligaments.

4) Estrogen:

- □ no. of oxytocin receptors.
- □ amount of contractile proteins.



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Figure 28.16

The Menopause



- **Def:**

Cessation of normal menstrual bleeding due to loss of ovarian function.

- **Timing:** between the ages of 45-55.

- **Causes:**

Decline in the number of primordial follicles
Unresponsiveness of the ovaries to the GnRH



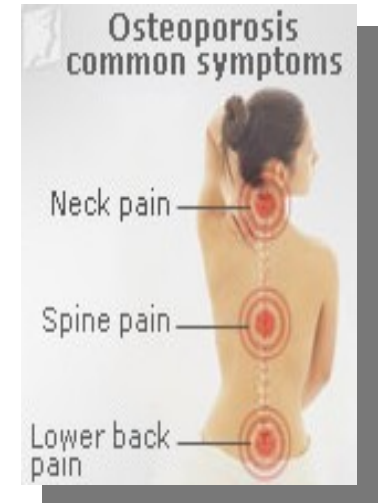
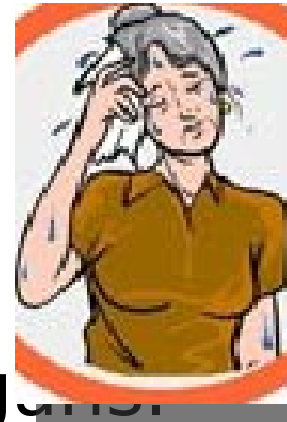
- ↓ Estradiol production from the ovary
- ↑ LH and FSH secretion due to loss of negative feedback.

So, menopause can be defined as **hypergonadotropic hypogonadism.**

The Menopause



■ Manifestation



- 1- Osteoporosis & wasting.
- 2- Atrophy of the 2ry sex organs.
- 3- Regression of the of 2ry sex characteristics.
- 4- Hot flushes (*coincide with surges of LH secretion*).
- 5- ↑ ed risk of cardiovascular diseases.

N.B: a period called perimenopause precedes

Lecture Quiz



Q. Which of the following statements is true regarding Human chorionic gonadotrophic hormone(hHCG)?

- a. decreases the secretion of the female sex hormones from the growing corpus luteum during early pregnancy.
- b. decreases the growth of the endometrium.
- c. Inhibits the growth of the male fetal testicles.
- d. Its peak level occurs 1- 2 weeks from the start of the ovum fertilization.

e. It stimulates the CTZ leading to morning sickness

Lecture Quiz



Q. Parturition is initiated by:

- a. parasympathetic stimulation.
- b. an increase in uterine responsiveness to oxytocin as a result of an increased concentration of myometrial oxytocin receptors.
- c. a drop in oxytocin secretion.
- d. a negative-feedback loop established between progesterone and oxytocin.
- e. a rise in progesterone secretion.

SUGGESTED TEXTBOOKS



1. Ganong's Review of Medical Physiology ,
23rd edition, Chapter 25.
2. Guyton & Hall: Textbook of Medical
Physiology, 12e (82) [pages: 1848-1869]

